Metabolic Heat Regenerated Temperature Swing Adsorption for CO2, Thermal and Humidity Control, Phase I

Completed Technology Project (2008 - 2008)

Project Introduction

Metabolic heat regenerated Temperature Swing Adsorption (MTSA) technology is proposed for a Portable Life Support System to remove and reject heat and carbon dioxide (CO2) regardless of the environment (lunar or Mars, vacuum or CO2), as well as to help control humidity in the ventilation loop. The basic principal is removal of metabolically-produced CO2 by an adsorbent with regeneration using a temperature swing. The lower temperature is achieved via expansion of liquid CO2 (LCO2). The higher temperature is achieved with metabolic heat from the moist ventilation loop gas through a condensing ice heat exchanger. The condensed water is saved and recycled at the habitat. Both the LCO2 exhaust and the metabolically-produced CO2 are rejected to the surrounding environment. The effective temperature swing is between the CO2 sublimation temperature (~195 K) and the ventilation loop gas temperature (~300 K). MTSA has reasonable mass, volume and power with minimal impact on infrastructure and operations. The basic principles of MTSA technology are well-proven, safe, do not rely on cryogenics, do not consume water but conserve it, are regenerable and will not compromise scientific investigations by sublimating water for heat rejection onto the premises. An added benefit of MTSA technology is that the LCO2 coolant can be produced and stored on the surface of Mars, saving launch costs and providing easy emergency access and replenishment. As Paragon has demonstrated adsorbent and LCO2 cooling performance relevant to MTSA operating conditions, Phase 1 will emphasize understanding the condensing ice heat exchanger design through analytical formulations and validation through testing. Paragon's unique experience will ensure that this Phase 1 effort will be successful, resulting in a strong Phase 2 MTSA development plan to design, build and test in a relevant environment a full-scale MTSA subsystem prototype.

Anticipated Benefits

Potential NASA Commercial Applications: Non-NASA applications include a wide variety of portable life support systems for the Department of Defense and Home Land defense in chemical warfare agent shelters. We also anticipate interest from the fire fighter community as LCO2 is a powerful means for safe thermal control that exhausts non-flammable, spent coolant. Developments made during this research will contribute to making personal LCO2 thermal control systems more affordable and reliable.

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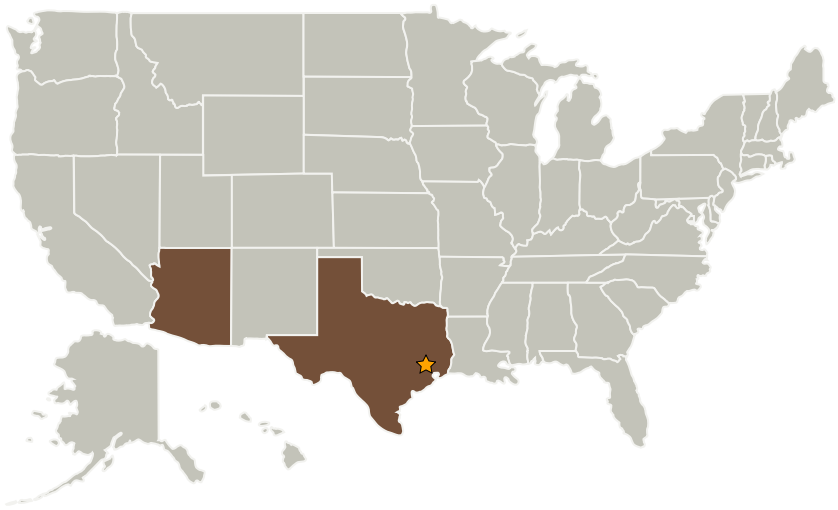
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
Paragon Space Development Corporation	Supporting Organization	Industry	Tucson, Arizona

Primary U.S. Work Locations	
Arizona	Texas

Project Transitions

February 2008: Project Start

July 2008: Closed out

Closeout Summary: Metabolic Heat Regenerated Temperature Swing Adsorption for CO2, Thermal and Humidity Control, Phase I Project Image

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

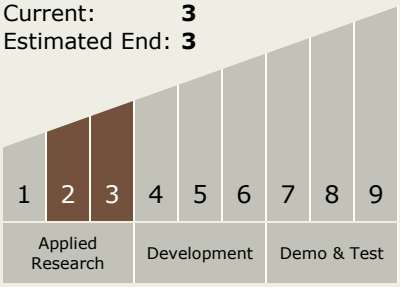
Carlos Torrez

Principal Investigator:

Christine Iacomini

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
  - TX13.4 Mission Success Technologies
    - TX13.4.6 Ground Analogs for Space/Surface Systems